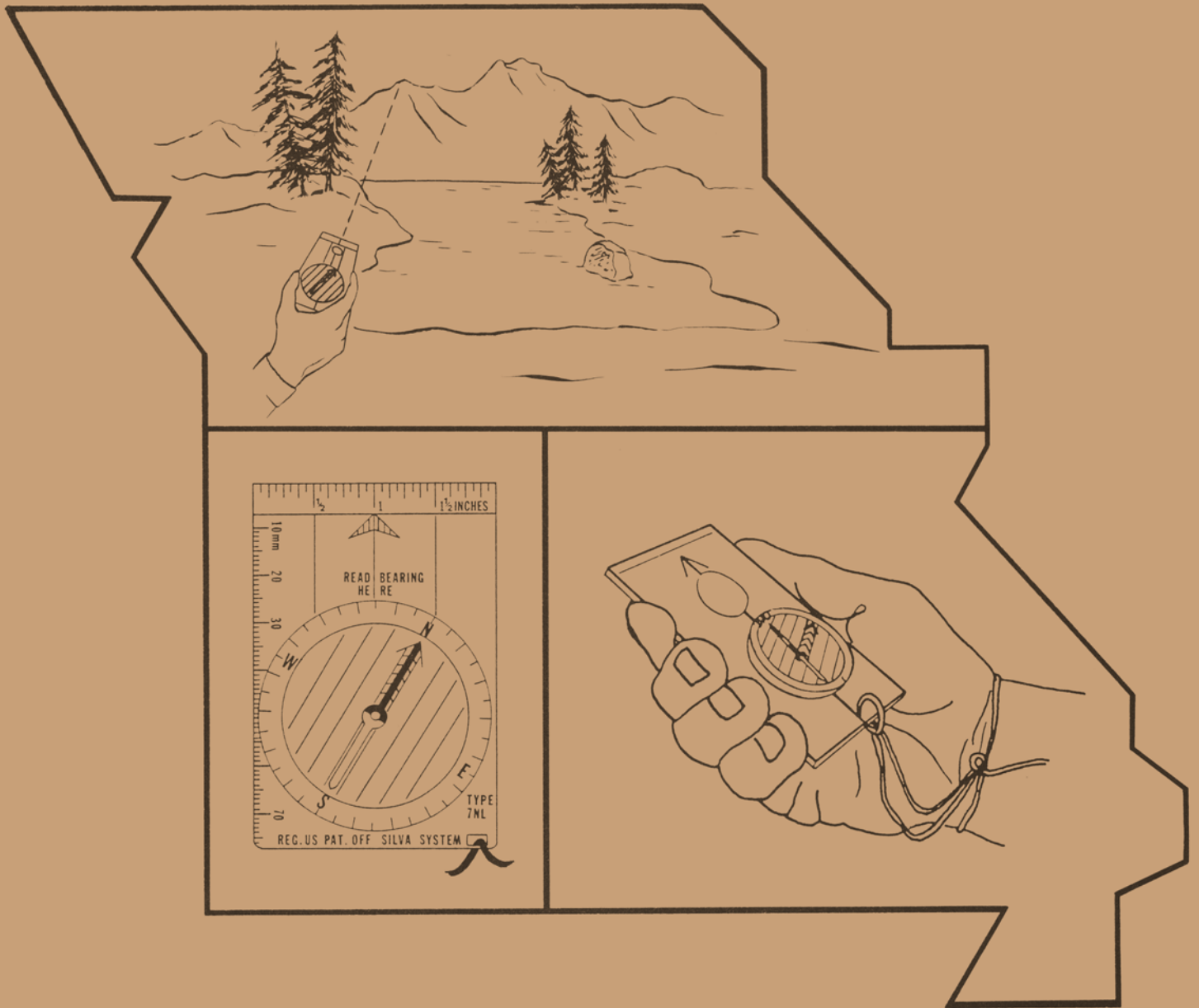


MAP AND COMPASS



By Dr. Gail S. Ludwig



MISSOURI DEPARTMENT OF CONSERVATION EDUCATION SECTION

**Copyright © 1983 by the Conservation Commission of the
State of Missouri. Second Edition, Revised 1986.**

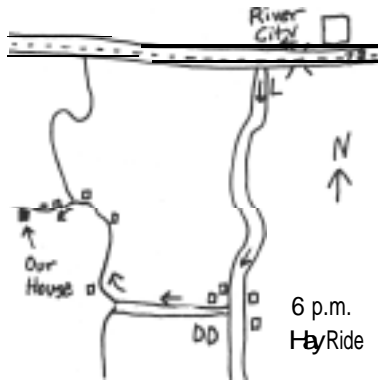
The Missouri Department of Conservation uses Federal financial assistance in Sport Fish and/or Wildlife Restoration. Because the state utilizes these federal funds, it must comply with federal anti-discrimination law. Under Title VI of the 1964 Civil Rights Act and Section 504 of the Rehabilitation Act of 1973, the federal government prohibits discrimination on the basis of race, color, national origin, disability, age or sex. If you believe that you have been discriminated against in any program, activity or facility as described above, or if you desire further information please write to:

The Office for Human Resources
U.S. Fish and Wildlife Service
Department of the Interior
Washington, DC 20240
and

Department of Conservation
P.O. Box 180
Jefferson City, MO 65102

Importance of Map and Compass

Use in daily activities



Map and compass skills are used every day by people from all walks of life. Vacation plans usually begin with a review of highway maps and maps provided by travel agencies. Simple sketch maps show the way to a friend's home, family reunion, or school picnic. Directions given by a service station attendant may begin with: "Go north two blocks, then turn right. Continue east until you reach..."

In addition to following directions and reading maps, most people have occasion to draw their own maps and give directions. The success of a backyard barbecue or a school field trip may rest upon how skillfully directions are given and taken.

Special uses



This lost hiker should have used a map and compass.

Map and compass skills are unique because they are useful and essential in a wide range of outdoor activities. Outdoor enthusiasts have a special need for such skills. Their activities take them away from familiar landmarks and the securities of civilization. Sportsmen travel with the terrain, not in a straight line, and can quickly become disoriented. Getting lost outdoors can range from an annoyance to a tragedy.

Besides safety, there are other uses for map and compass skills. Hunters and fishermen can use direction-finding and map reading skills to locate favorite hunting and fishing spots. Many outdoor professions-forestry, engineering, surveying-depend on the ability to use maps and compasses accurately.

A map and compass function best when they are used together as a team. But first, it's best to learn to use each separately.

Maps

Definition of a map

What is a map? It's more than a sheet of paper with lines drawn on it. A map represents a portion of the surface of the earth as it would be viewed from a vertical perspective. This representation is reduced to a usable size.



Road map

Topographic maps

Note to instructors: Have topographic maps available for students to use.



Topographic map, 1:24,000

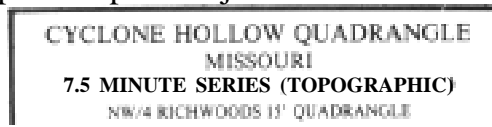
There are many kinds of maps. The most common is the road map showing transportation routes and cities. Soil maps tell what kinds of soils are found in an area. Geological maps show the structure of the earth's crust, types of rocks, and forms of life found as fossils in a given area. Land use maps show how a portion of the earth's surface is being used. Topographic maps show the physical and cultural characteristics of an area which includes: elevation; rivers, streams, and reservoirs; roads and hiking trails; cities and villages; and a multitude of other features.

For general outdoor use, the United States Geological Survey (USGS) topographic maps are considered best (see bibliography). These maps come in several sizes and scales, but the one most often used is the 1:24,000 scale or 7.5 minute quadrangle map. (These terms will be explained shortly.)

Compare the features of a road map with those of a topographic map. Both are graphic representations of a portion of the earth's surface at a reduced scale. The road map plots position and distance of cities and roads, but it tells nothing about the terrain. The topographic map shows cultural features such as towns and highways too. But natural features also are included and, perhaps most important, contours which show the shape and elevation of the land.

A topographic map contains more information than a road map, so you need more skill to read it. The first step is to study the map's margin.

Items printed in the map's margins are called descriptors. The map name appears in the top and bottom margin and is often determined by the main feature in the area covered. Words in parentheses in the margins are names for topographic maps of adjacent areas.



Map descriptors

In order to locate places, features, or areas on a map, ancient mapmakers devised a system of lines—a grid that fits the earth. There are many different grid systems used by professional geographers and cartographers but by far the most common grid system used is latitude/longitude.

LATITUDE/LONGITUDE

The latitude/longitude grid system is one of several systems used on USGS topographic maps. Numbers in the margin, such as 38 '22'30" indicate either the latitude or longitude of the area covered by the map. These numbers pinpoint the area's location on the globe.

Lines of longitude (also called meridians) run from the North Pole to the South Pole and completely circle the globe. The prime meridian which runs through Greenwich, England, is given a value of zero degrees. All other meridians are given a value based on their positions east or west of the prime meridian.

Longitude values on topographic maps are found along the top and bottom edges of the map. For the continental U.S. these values will range between approximately 70°W on the coast of Maine and 125 °W on the west coast of California.

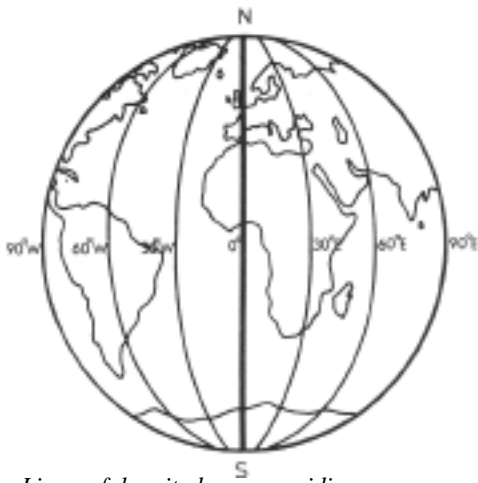
A series of horizontal lines that run in an east-west direction around the globe are called lines of latitude. The equator is identified as zero degrees. The North Pole is 90°N and the South Pole is 90°S. Lines of latitude are often called parallels because each line is equal distance from the other and are assigned values based on their position north or south of the Equator.

Latitude values on topographic maps are located along the sides of the map. The lower 48 states lie between 48 °N latitude (Maine) and 26°N latitude (southern Texas).

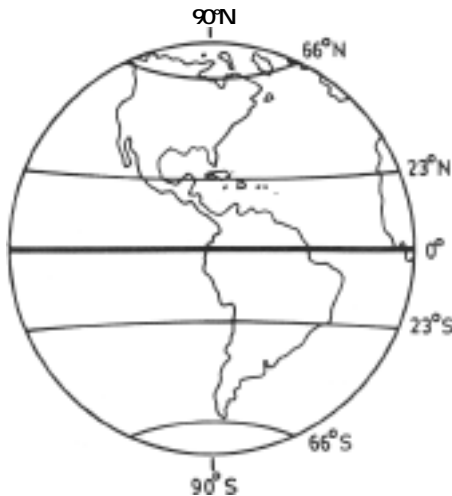
The values assigned to lines of latitude and longitude are expressed in degrees of a circle and are further broken down into minutes and seconds. A degree has 60 minutes, and a minute has 60 seconds. Latitude lines range from zero degrees at the Equator to 90 degrees north or south at the respective poles. Longitude lines have values ranging from zero degrees at the prime meridian to 180 degrees at the International Date Line. Thus a latitude measurement of 37° 15'30"N appearing in a map margin would be read as "37 degrees, 15 minutes, 30 seconds, north latitude." A longitude value appearing in the upper or lower map margin of would be read as "92 degrees, 15 minutes, west longitude." You can pinpoint any location on earth by finding the point where the two coordinates, latitude and longitude, intersect.

Topographic maps are sometimes identified using the area of longitude covered by the map sheet. Thus a USGS "15 minute" topographic map covers 15 minutes of longitude or approximately 18 miles, while a "7.5 minute" topographic map covers approximately 7 miles.

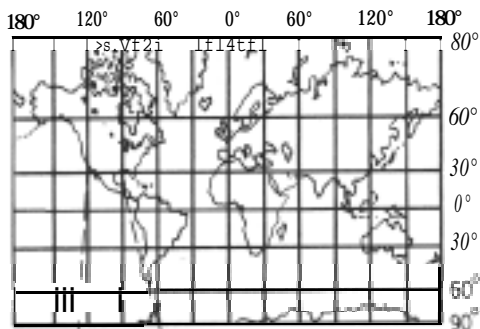
Other descriptors are also contained in the map margins. Dates given at the bottom of the map indicate when the map was made and field-checked. These dates are important because new features may not be shown. A highway, lake, or subdivision may have appeared since the map was made and field-checked.



*Lines of longitude, or meridians, measured in degrees.
0° - prime meridian*



*Lines of latitude, or parallels, measured in degrees.
0° = Equator*



You can pinpoint any location by finding the point where latitude and longitude lines intersect.

During field-checking, surveyors may visit the area represented by the map. They will note the accuracy of map measurements and examine the area for any new features that may have appeared since the map was made. Most frequently, topographic maps are field-checked by taking an aerial photograph and examining it for changes or additions. For example, a river may be dammed to form a lake, a subdivision might be constructed in a meadow, or a hill might be leveled to make way for a new highway. These changes can be quickly and accurately identified by using aerial photography.

SCALE

When using maps it is essential to know how far it is from one location to another. If a secluded lake or reservoir is located on a map and you would like to hike into it to go fishing, you need to know if you will be walking 1 mile, 5 miles, or 50 miles-especially if you are carrying a canoe and fishing gear! When you need information on distance, it usually is impractical to measure the distance on foot. The easiest method is to understand the concept of map scale. Scale is the proportion between distance on the map and distance on the earth (or in the field). Since a map is smaller than the area it represents, a *ratio* can be established between map distance and actual ground distance.

If your fishing lake were located on the map one inch from the end of the road and the scale on the map were 1:100, you could accurately say that the lake was actually 100 inches from the end of the road (1 inch on the map = 100 inches on the ground). This could then be translated into an understandable distance of about 8 feet (100 inches divided by 12 equals 8). In this case you could not only drag a boat or canoe to the lake, but take along a cooler, lawn chairs, motor, and other necessary gear.

EXAMPLES OF RATIO MAP SCALES

To show why a complete understanding of scale is important, let's decrease the scale of the fishing lake map to 1:250,000. In this case, the one inch from the road end to the lake on the map would be 250,000 inches on the ground-250,000 inches is much farther than the original 100 inches. In fact, the distance to the lake increased to about 4 miles (250,000 inches divided by 12 equals 20,833 feet and 20,833 feet divided by 5,280 ft./mile equals 3.9 miles).

Dragging a canoe or boat, cooler, and other gear would be quite difficult over this distance-in fact, you probably would limit your gear significantly!

Common scales used on USGS topographic maps are: 1:250,000; 1:62,500; and 1:24,000. This means that one inch on the map represents 250,000 inches; 62,500 inches; or 24,000 inches in the field, respectively. These scales represent convenient measurements for conventional maps. They are designed to show adequate detail without being excessively



National Map Series
 1:250,000 scale
 1 inch = 3.9457 miles
 Area shown = 97.3 square miles



15-Minute Map Series
 1:62,500 scale
 1 inch = 0.9864 mile
 Area shown = 6.08 square miles



7 1/2-Minute Map Series
 1:24,000 scale
 1 inch = 2,000 feet
 Area shown = 0.87 square miles

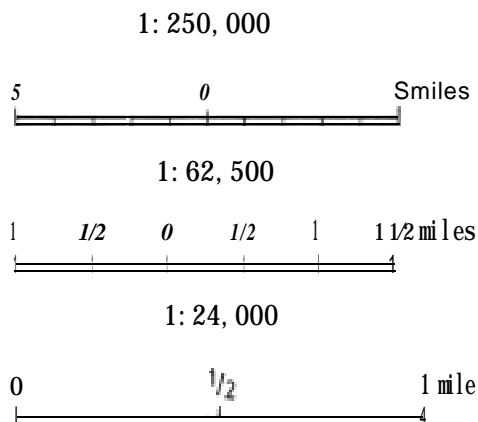
large. The smaller the scale ratio, the larger the area covered. The larger the scale ratio, the greater the detail shown. (See map examples of scales.)

At first glance, these ratios may seem rather arbitrary. But actually, they figure out to scales that people can more easily understand. This removes some of the mystery. A scale of 1:250,000 represents one inch on the map to about four miles in the field. A scale of 1:62,500 represents one inch to about one mile, and 1:24,000 represents one inch to about 2,000 feet or a third of a mile. The last scale shows the greatest detail but covers the smallest area.

Another common type of scale showing map distance to ground distance is called a graphic or bar scale. This is a small ruler type of scale that appears on the bottom of most USGS maps. The bar scale shows graphically the distances represented on the map. Usually they are read from left to right with units such as inches, feet, yards, or miles identified for the map user. All one needs to do is measure the distance from one point to another on the map and compare it to the bar scale to easily compute how far it is between the two points.

A working knowledge of both ratio scales and bar scales is essential for map users. Both scales are useful in particular instances and can be adapted to a variety of uses. Sometimes using a small hand calculator can help in doing the mathematics and computations necessary to compute scale. But remember, often a calculator is not available when you are backpacking, fishing, or hiking—so be sure to familiarize yourself thoroughly with scale before attempting to go off on your own. Try several of the exercises in the lesson plans.

Bar Scale

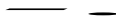







SYMBOLS

Maps are constructed with a variety of symbols. Some look like what they represent, while others may be confusing and abstract. Symbols must be used on maps to show

Map Symbol Examples

(See Appendix 1 for Map Legend)

Primary high way (red)	
Secondary highway (red)	
Wooded marsh or swamp (green)	
Index contour (brown)	
Intermediate contour (brown)	
Depression contours	

features because it is impossible to realistically identify objects such as buildings, trees, and highways as they appear to us. Learning to identify common symbols is easy and as you begin to familiarize yourself with them, your mind often will immediately transfer the symbol on the map to what you really see when you look over the terrain.

Colors also are important to map users. If you do not understand the use of colors on a USGS map you may find yourself wading through a waist deep pond instead of a dry meadow. Colors show different types of features. Black represents man-made or cultural features; white represents open areas; blue represent water features; green represents vegetation; and brown represents elevation or “relief.” Symbols and colors are used together to represent features on a map. Examples of individual symbols are shown at left and a map legend is in Appendix 1. A complete list of symbols is available from the USGS (see bibliography).

CONTOUR LINES

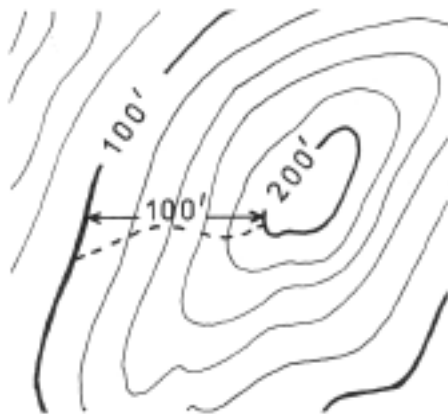
Light brown lines on the map are called contour lines. Contour lines connect points which have the same elevation. Contour lines were first used on land maps in the eighteenth century; however, they did not become popular until recently because they require that elevations be precisely determined and located on a map.

Contour lines may seem confusing at first; but with practice, you can learn to “view” contour lines as different elevations. Since each line represents the same elevation, they reflect the terrain or changes in elevation of the area and can help to interpret the landscape accurately.

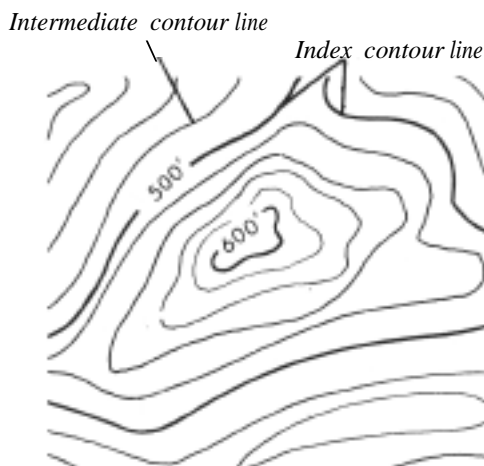
Contour lines are spaced according to regular variations in elevation called contour intervals. The contour interval of the map appears in the lower margin. Thus, a contour interval of 20 feet means that between two consecutive contour lines on the map, the actual elevation changes 20 feet. If you were hiking a trail that crossed 5 contour lines on your map in a distance of one mile, you would know that you had to climb 100 feet (5 lines x 20 feet/line equals 100 feet).

One important fact to remember is that the closer the lines are, the steeper the terrain. A meadow or field with few contour lines running through it will be relatively flat *if* the contour interval is low (i.e., 5-10 feet). That same flat-looking area could be a steep slope if the contour interval were 75-100 feet. The trail that we previously said crossed 5 contour lines in one mile only rose 100 feet, but if the contour interval were 100 feet then the rise would be 500 feet and you had better take ropes and climbing gear if you want to use that portion of the “trail.”

Two kinds of contour lines appear on topographic maps: index lines and intermediate lines. Numbers spaced periodically along an index line show its elevation (in feet)



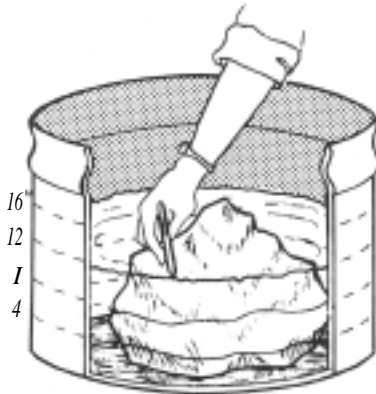
Contour intervals are 20 feet on this map.



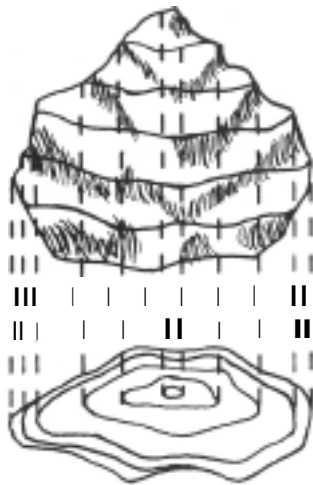
In this illustration, index contour lines indicate every 100 feet. Intermediate contour lines mark every 20 feet increase in elevation.



Variations in the coastline as the tides rise and fall.



Marking the water level on the rock in four-inch increments.



Contour drawing of lines on the rock.

above sea level. An index line is darker in color. The lighter brown lines between index lines are the intermediate lines.

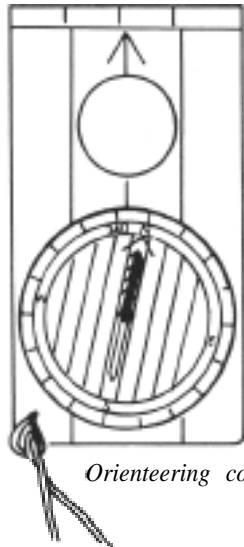
A simple way to imagine contour lines is to think of them as shorelines. Using the 20-foot contour interval as an example, imagine that the lines represent the shoreline of the ocean and that the water level is rising in 20-foot increments. Thus, contour lines close together indicate a steep shoreline while lines spaced farther apart represent a more gentle drop.

Another way to understand contour lines is to use a large (basketball size), irregular object like a rock. Set the object in a watertight tub deep enough to submerge the entire object. Looking down on the object, draw a line with a grease pencil around its widest circumference. Now fill the tub with water to the depth of four inches. Mark the waterline on the object with the grease pencil. Add water to raise the water level by another four inches and repeat the marking procedure. Continue until the object is completely submerged. Now remove it from the tub. It should be inscribed with a series of irregular, concentric circles.

Looking down on the object from directly above, draw its outline and the various waterlines on a piece of paper. The completed drawing is a contour map of the object—a two-dimensional representation of a three-dimensional object. The contour interval in this instance is four inches.

The skill of interpreting topographic maps is not difficult, but it does require practice. Some of the activities listed at the end of the module will help you develop this skill. To obtain topographic maps, see the bibliography.

Compasses



Magnetic compasses

Orienteering compass

Basic principle of a compass

Once the basic skills of map interpretation have been mastered, it is time to work on the skill of compass reading.

The compass is the basic direction-finding device in terrestrial navigation. There are three categories of compasses: magnetic compasses depend on the earth's magnetic field, gyrocompasses rely on the rotation of the earth, and solar compasses use the location of the sun and stars. For our purposes, the magnetic compass is the simplest to use, and further discussion will be confined to this type of instrument.

There are several types of magnetic compasses. Some have special uses and others are for general use.

For serious map and compass work, the best type of compass is an *Orienteering compass* (see diagram). This compass is especially designed for use with topographic maps and is inexpensive and durable.

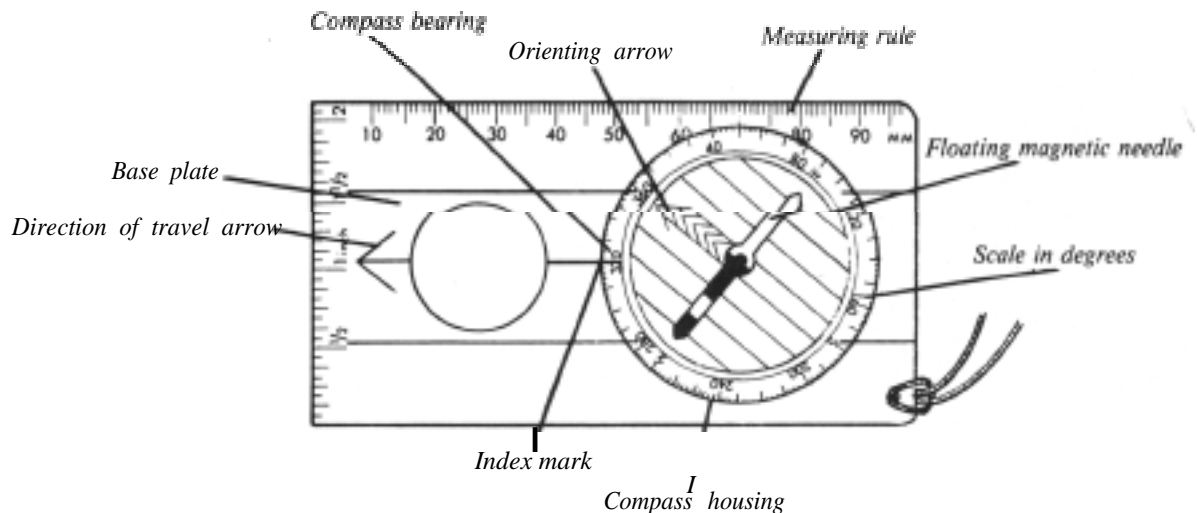
The magnetic compass works on the principle that the earth is a giant magnet and generates a magnetic field running north and south exactly like a bar magnet. A freely suspended iron needle will align itself with the lines of magnetic force of the earth. There are several difficulties with the use of a magnetic compass. First, the earth's magnetic field does not coincide exactly with its polar axis. Thus the magnetic north pole and the true North Pole are some distance apart. As you will learn in this unit, however, it is quite easy to correct the error caused by this discrepancy. If you are close to the North Pole, however, the compass needle tends to point south. For general use in our area, this is not a major problem. Finally, metal objects, such as belt buckles, boats, automobiles, or even large iron ore deposits in the earth, can cause a compass to give misleading information. The metal interferes with the compass needle's response to the magnetic north pole. These are minor problems and can be easily corrected if you are aware of a compass' limitations.

Parts of an Orienteering compass

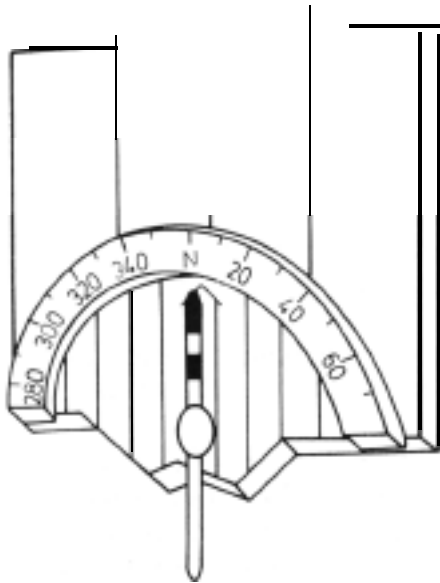
The Orienteering compass consists of three basic parts: magnetic needle, a revolving compass housing, and a transparent base plate. Each has its own special function. Together they give you instant directions, combining compass, protractor, and ruler into a single tool.

Etched on the bottom of the housing is the orienting arrow. Around the housing margin is the scale graduated in 360 degrees of a circle (north is at 0 degrees and south is at 180 degrees). The compass housing can be rotated on the base plate independent from the needle. Inscribed on the base plate, in line with the direction-of-travel arrow, is the

index mark. The number appearing over or adjacent to the index mark is called the compass bearing.



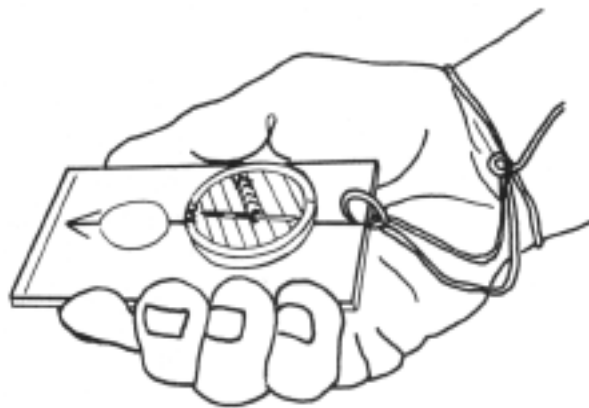
Finding direction using a compass



To find north, set your compass to look like this.

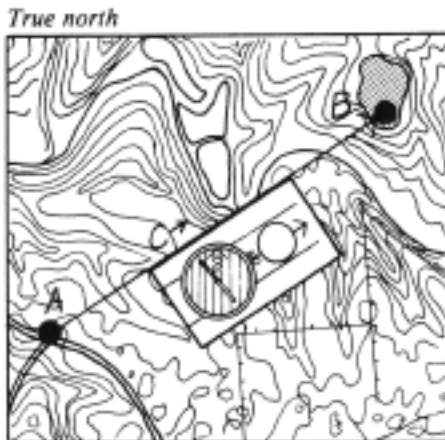
Finding direction with an Orienteering compass is easy. To locate a specific direction—for example, north—rotate the compass housing so 0° (north) is directly over the index mark. Hold the compass at your waist. Be careful of nearby metal objects, such as belt buckles, automobiles, or metal buildings which might influence the needle. Turn your body holding the compass steady until the red end of the floating needle is aligned with the orienting arrow etched on the bottom of the compass housing. Look up—the direction you are facing is north. This procedure is called “setting a bearing.”

To determine the direction of a distant object with an Orienteering compass, face the direction in question. Hold the compass either waist or chest high with the travel arrow pointing straight ahead and the protractor plate level. Now rotate the compass housing until the floating needle is aligned over the orienting arrow etched on the bottom of the compass housing. The north end of the needle should point toward the tip of the orienting arrow. Read the bearing, in degrees, from the scale at the index mark. This procedure is called “taking a bearing.”



Hold the compass at waist level with the direction of travel arrow pointing straight ahead, then rotate the compass housing until the floating needle (red end) is aligned over the orienting arrow. Keep the compass level.

Finding direction from a map



A = Reference point (road junction)
B = Destination (pond)
C = Direction-of-travel line
60° = Bearing at index mark

Finding direction from a map is just as simple. First note that the top of the topographic map is true north. Select a point on the map to serve as a base or reference point—a road junction, for example. Select a second point, such as a pond, to serve as a destination. An arrow drawn from the reference point to the destination point indicates the direction of travel. Place the compass on the map so that the base plate lies along the direction-of-travel line you have drawn on the map. The direction-of-travel arrow on the compass should also point in this direction. With the compass in this position, rotate the compass housing until the orienting arrow etched on the bottom of the compass points north (top of the map). Read the bearing on the compass dial at the index mark. This compass bearing is then the direction you should follow from the road junction to the pond.

Note that the floating needle is ignored throughout this procedure. Also note that the bearing arrived at is the true bearing. It probably will not be the same bearing obtained from actual measurements in the field. The next section explains why.

Using Map and Compass Together

A compass needle points toward magnetic north. The top of a topographic map indicates true north.

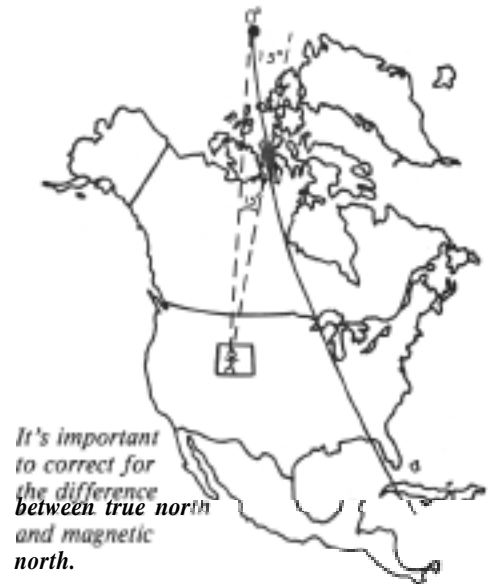


As mentioned earlier, map and compass are a team. Each can work independently, but they function best together. Before you use map and compass together, however, it is necessary to understand some of the limitations of each.

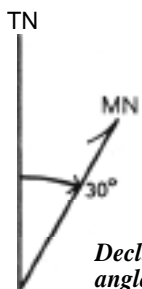
A compass needle points toward magnetic north. The top of the topographic map indicates true north, which differs from magnetic north.

True north is the actual north polar axis of the earth. Magnetic north is an area near Hudson Bay—over 1,000 miles from the true North Pole. It is difficult to give an exact location for the magnetic north pole because it moves. Reasons for this movement are complex and changes occur irregularly over hundreds of years. The difference between true north and magnetic north can vary greatly in different parts of the U.S. The only place in our hemisphere where true north and magnetic north coincide is on a line (called the agonic line) that runs from the west coast of Florida through Lake Michigan to the magnetic north pole. At any point between this zero line and the Atlantic Ocean, the compass needle points west of true north. At any point between the zero line and the Pacific Ocean, the floating needle points east of true north.

This discrepancy between map “language” and compass “language” is extremely important to anyone using map and compass together. For example, consider a hiker or hunter in Wyoming where the compass needle points 15 degrees east of



true north. If the sportsman takes a bearing from his map and sets it on the compass without correcting for the 15-degree error and then starts following the bearing, he will be one-fourth mile off course after only one mile of travel. For every four miles he walks, he will move a full mile farther off course. In Missouri, declination varies to 6 degrees so it is not such a significant difference. Fortunately, there is a simple procedure for making map and compass speak the same language.



Declination

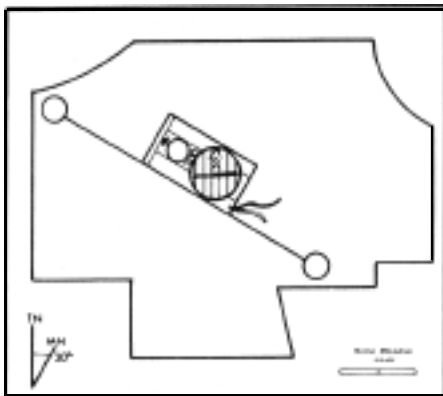
Declination symbol showing 30° angle to the east.

Correct declination mathematically:

Declination east-compass least (subtract)

Declination west-compass best (add)

Correct declination on the map:



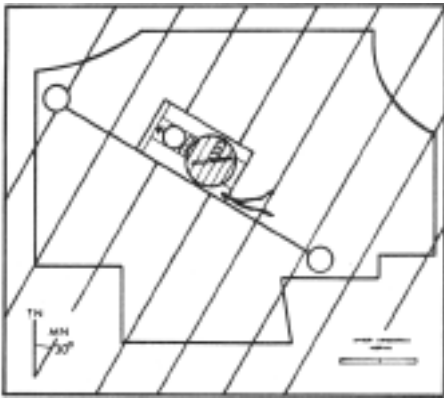
Compass reads 300° before correcting for 30° declination.

The angular variation between true north and magnetic north is called declination. A knowledge of declination is used two ways: (1) to adjust a compass (magnetic) reading to a map (true reading) and (2) to convert a true reading (taken from a map) to a magnetic reading that can be followed with a compass.

A symbol for declination, accompanied by a number, appears in the lower margin of all USGS topographic maps. The number is the declination for the area covered by the map. The symbol indicates whether the declination is east or west.

Two kinds of bearings are used with map and compass. A bearing taken from an object on the landscape is a *compass bearing*. It must be converted to a true bearing to be transferred to the map. When transferring compass bearings to a map, you must add easterly declination and subtract westerly declination, which is exactly the opposite of the adjustment you make when working from map to compass. A bearing taken from the map is called a map bearing or *true bearing* and must be converted to a compass bearing before use in the field. To follow a bearing taken from a map with a compass, you must subtract easterly declination and add westerly declination.

For example, consider again the sportsman in Wyoming. As explained, failure to correct for the 15 degree easterly



Extend magnetic north lines across page. Rotate compass housing so orienting arrow is parallel with magnetic lines. Now compass reads 270°



Map with magnetic lines drawn. This method avoids adding and subtracting declination.

Following a compass course taken from a map

declination could put the person seriously off course. To prevent this, the sportsman should reset his compass. Because the compass needle points 15 degrees east of true north, 15 degrees should be subtracted from the map bearing (true bearing) to be followed. Subtracting compensates for the easterly error. Anyone following a map course in the eastern U.S., where the declination is west would correct the bearing by adding the appropriate number.

A simple device for remembering whether to add or subtract declination is the rhyme: "Declination east-compass least; declination west-compass best." So, for an easterly declination, the compass bearing should be less than the true bearing (compass least-subtract). For a westerly declination, the compass bearing should be greater than the true bearing (compass best-add). This procedure applies whenever a compass is set to a true (map) bearing (converting true bearing to magnetic bearing).

When you are using maps in the field, you can use a simpler method to correct the declination.

1. With a pencil and straightedge, extend the magnetic north arrow in the bottom margin of the map across the face of the map.
2. Draw a series of lines parallel to the first line about 2 inches apart. Space them evenly over the entire surface of the map.
3. Now, to take a map bearing, use the same procedure explained in the map section with one important exception: instead of rotating the compass housing until the orienting arrow is pointing to the top of the map, or true north, rotate the housing until the orienting arrow is aligned with the magnetic north lines you have penciled in. Any bearing taken from the map using this procedure can be followed directly in the field-without other compensation for declination.

This method avoids adding and subtracting because instead of aligning the compass orienting arrow with the top of the map, you align it with magnetic north. Thus all bearings are automatically converted to map "language" or true bearings. Similarly, any bearing taken from an object in the field can be plotted directly on the map, using the magnetic north lines, without further compensation for declination. By drawing those lines lightly on the map, all the adding and subtracting is unnecessary.

Steps in following a map course with a compass are easy.

1. First, on the map, align the direction-of-travel arrow on the compass with the desired route. Disregard the floating needle.
2. Now set the compass housing so that the etched orienting arrow in the base of the compass housing is aligned with the magnetic north lines you have drawn on the map.
3. If you have not added magnetic north lines, rotate the compass housing until the orienting arrow points to the



Don't forget to look where you are going.

top of the map (north) and then add or subtract the proper declination to the bearing shown.

4. Make sure the compass base plate stays aligned with the travel route shown on the map until the bearing is read. Now take the compass off the map and hold it level at waist height with the direction-of-travel arrow pointing ahead.

5. Slowly turn your body until the floating needle is directly over the etched orienting arrow. The direction-of-travel arrow on the compass base plate now points toward the destination shown on the map.

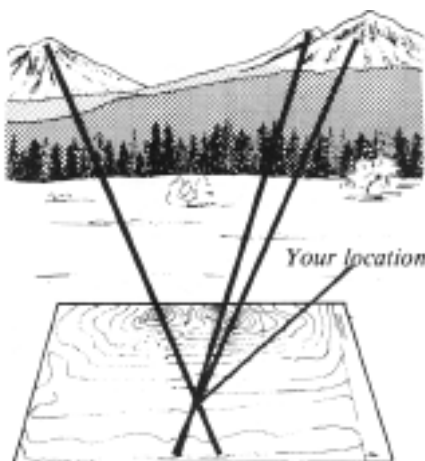
When you are on a compass course, it is best to follow visible landmarks along the route. Take short sections of a long route and walk from landmark to landmark rechecking the bearing periodically. This is safer and faster than charging over the landscape for long distances with your head down, watching the compass needle.

When you work with map and compass in the field, position the map so that its direction corresponds to directions in the field. To orient a map, simply set the compass to zero bearing and align the base plate with one of the magnetic north lines. Turn the map and compass together until the floating needle is aligned with the orienting arrow. The map is now oriented to the landscape so objects in the field will appear in the same direction as on the map.



Align the compass with your desired route on the map.

Resectioning



Align landmark with its symbol on the map.

The compass is used most often to follow a route laid out on a topographic map. Sometimes, however, you may want to take compass bearings from objects in the field and plot their location on a map. Outdoor enthusiasts can use this procedure, called resectioning, to identify a favorite spot for fishing, hunting, or other activity. Resectioning has only one prerequisite—there must be at least two, but preferably three, identifiable points on the landscape that also appear on the map.

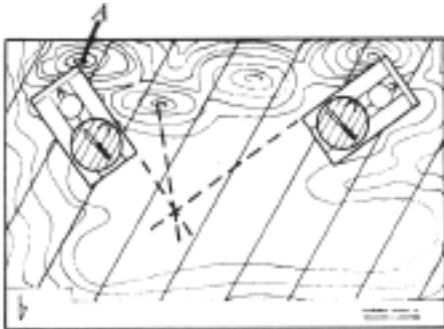
RESECTIONING WITHOUT A COMPASS

To resection without a compass:

1. Orient the map by inspection—that is, align the map on the ground so that the two or more landmarks selected to serve as references appear on the map in the same orientation that they appear on the landscape.



Take a compass bearing from first landmark.



Transfer your bearing to the map.

2. With a straight stick, align the distant landmark with its symbol on the map.

3. Draw a line across the map so that when you sight over the line, the distant landmark appears.

4. Repeat this procedure for each landmark without moving the map.

RESECTIONING WITH A COMPASS

To resection with a compass:

1. Select three landmarks to serve as reference points.

2. Take a compass bearing from your location to the first landmark.

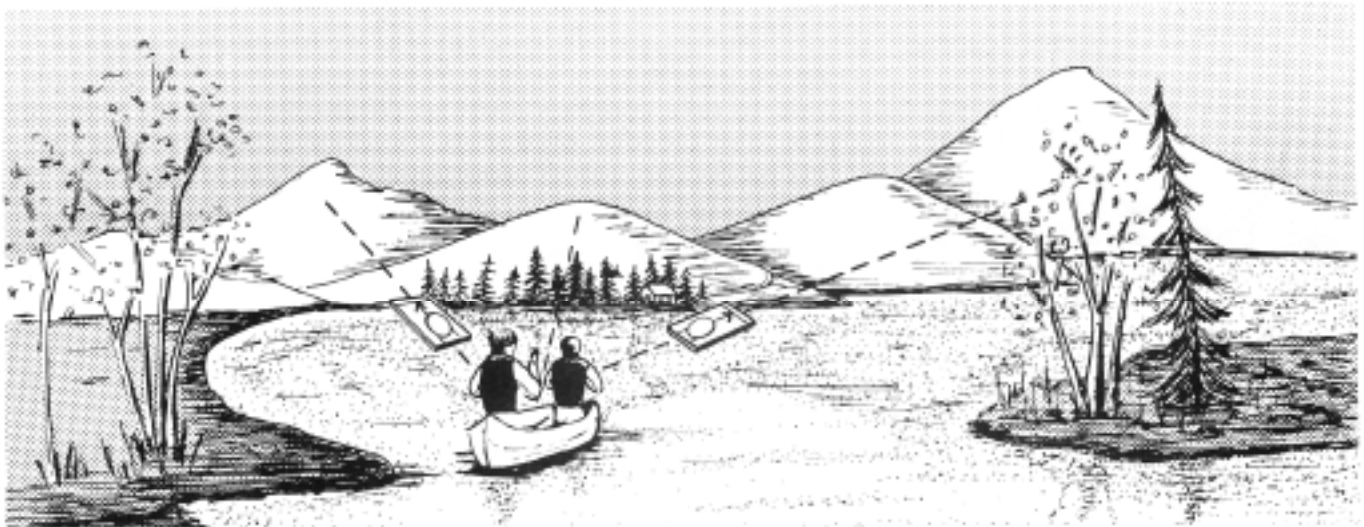
3. Transfer the bearing to the map by laying the compass on the map so that the edge of the base plate touches the landmark symbol. (See A on diagram.)

4. Without changing the bearing, swing the entire compass (keeping the edge of the base plate on the landmark) until the orienting arrow becomes aligned with the magnetic north lines drawn on the map. Make sure your orienting arrow points in the proper direction. If you have not drawn magnetic north lines, you will need to correct for declination.

5. Draw a line passing through the landmark symbol using the compass base plate as a straightedge.

6. Take a compass bearing from the other landmarks and transfer to the map as before. The point or area at which the lines intersect is your location.

For best results when resectioning, use landmarks that are at about 45-to 90-degree angles from each other. Landmarks within 45 degrees of each other are subject to greater error. Often you have small errors in your readings. Thus, if you use three points when you resection, you create a "triangle of error." Your location is within this triangle of error. If this triangle is extremely large, recheck your bearings. One of them may be miscalculated.



When resectioning, use landmarks that are at about 45-to 90-degree angles from each other.